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## A PECULIAR TYPE OF NEPHRIDIA IN NEMERTEANS.

WESLEY R. COE.

The excretory apparatus of the nemerteans has long been known to present great variation in form and structure in different members of the group. In many of the smaller and less highly specialized forms the apparatus presents a close similarity to that of the planarians and has evidently been derived from a similar type. In many species a profusely branching system of tubules lying in close proximity to the blood vessels connects with a single excretory pore on each side of the body, while in other forms the number of such efferent openings may be increased to the number of thirty or more on each side, as in some species of the genus *Lineus*. Although limited to the cephalic or a small portion of the esophageal region in some species, the system extends throughout the entire length of the body in other forms, as in the fresh-water *Stichostemma*. In a few species which have been carefully studied the system has not yet been discovered, in some cases perhaps owing to the difficulty of distinguishing the delicate nephridial tubules from the branches of the thin-walled blood vessels.

With the exception of certain species of the genus *Tæniosoma* (*Eupolia*) all nemerteans in which the relationships of the nephridial system are known agree in one important feature, namely, in that these excretory tubules, whatever their structure or position, open and discharge their contents directly upon the exterior of the body.

Several years ago Punnett,<sup>1</sup> in investigating the anatomy of *Tæniosoma quinquelineatum* (*Eupolia melanogramma* Punnett), found that this species possesses a considerable number of efferent nephridial ducts, some of which open on the exterior of the body, as usual, while others pass inward through the epithelium

<sup>1</sup>Punnett, R. C., "On a Collection of Nemerteans from Singapore," *Quart. Journ. Micr. Sci.*, Vol. 44, p. 116, 1900.

of the esophagus and open into the lumen of this portion of the alimentary canal.

In a recent study of a species of the same genus (*Tæniosoma cingulatum* Coe) from the Hawaiian Islands, I have found a very similar condition.<sup>1</sup> In this species the nephridial ducts are profusely branched, and extend through the posterior three fifths of the esophageal region. The branches are of rather large size and are situated on the lateral walls of the esophageal blood lacunæ, in close contact with the epithelial lining of the blood spaces (Figs. 1, 2, 3).

The total number of efferent ducts is between ten and thirty on

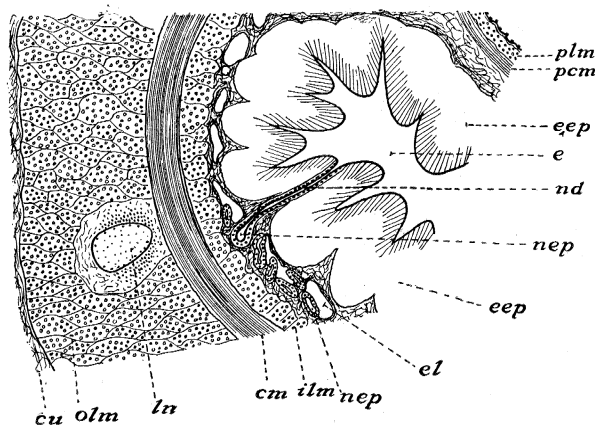


FIG. 1. *Tæniosoma cingulatum*. Portion of transverse section of body through esophageal region, showing efferent duct (*nd*) leading from a large nephridial canal (*nep*) through esophageal epithelium (*eep*) to lumen of esophagus (*e*); *el*, esophageal blood lacuna; *cu*, cutis; *olm* and *ilm*, outer and inner longitudinal muscular layers respectively; *cm*, circular muscular layer; *ln*, lateral nerve; *plm* and *pcm*, longitudinal and circular muscles of proboscis sheath.  $\times 75$ .

each side of the body, and those which open into the esophagus are interspersed irregularly with those opening upon the external surface of the body. The average position of those opening externally, however, is somewhat more anterior than that of those leading to the esophagus. The latter are more numerous than the former, and are much the more conspicuous. The appear-

<sup>1</sup> Coe, W. R., "Nemerteans of the Hawaiian Islands, Collected by the Steamer Albatross in 1902," Bull. U. S. Fish Com., 1903, p. 984, 1906.

ance would indicate that the ducts opening into the esophagus furnish the principal course for the discharge of the excretory products, while those which pass externally are little more than vestiges of the primitive condition, for many of the latter are incomplete and fail to reach the surface.

The efferent ducts which open into the esophagus exhibit a distinct, though thin-walled, tube passing directly from one of the larger nephridial canals to the surface of the epithelium lining the esophagus (Figs. 1, 2, 3). The presence of a distinct lumen throughout the whole length of some of the ducts does not leave the slightest doubt as to the actual communication between the nephridial canals and the lumen of the esophagus.

In all cases the openings of the nephridial ducts are on the

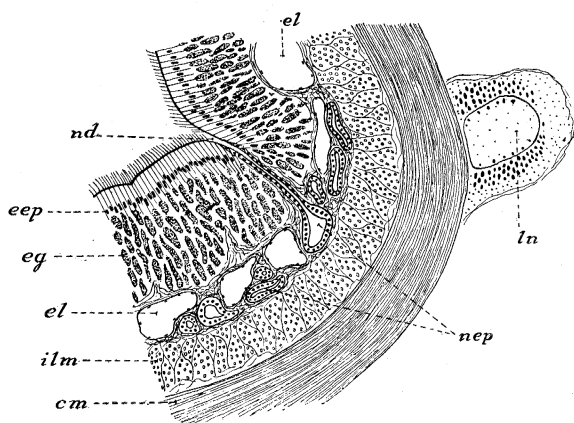


FIG. 2. *Tæniosoma cingulatum*. Portion of transverse section of body through middle of esophageal region, showing efferent nephridial duct opening into lumen of esophagus. Reference letters as in Fig. 1.  $\times 130$ .

ventro-lateral borders of the esophagus and in the vicinity of the lateral nerves (Figs. 1, 2, 3).

During the movements of the body the cavity of the esophagus is continually changing in outline, and the epithelial lining is thrown up into numerous temporary longitudinal ridges. Such ridges may form either in the vicinity of the nephridial openings or between them. In the former case the nephridial duct is greatly elongated and very slender and opens on the side or

summit of the ridge, whereas if the opening is between two such ridges the duct is necessarily short and has a correspondingly thicker epithelial lining. The length of the nephridial duct must thus vary in accord with different degrees of extension of the esophageal walls and the accompanying changes in the height of the longitudinal ridges.

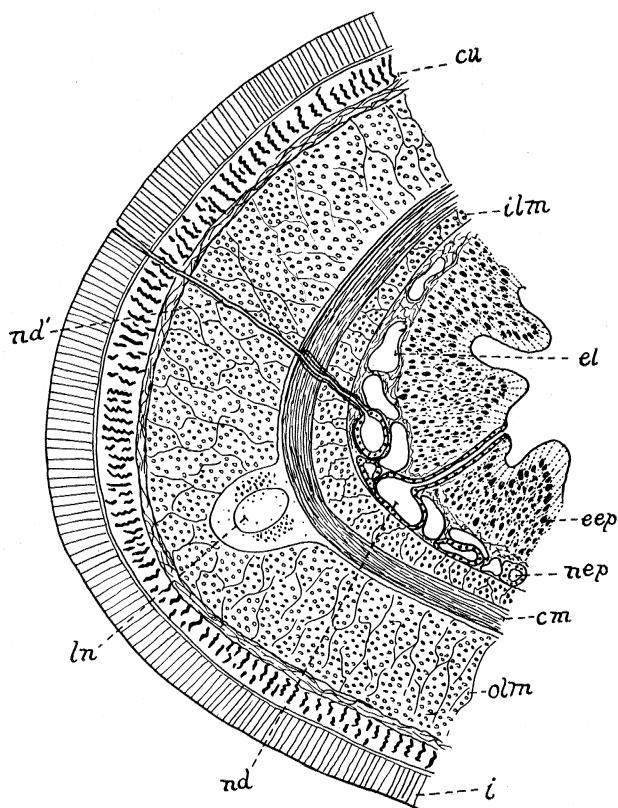


FIG. 3. *Tieniosoma cingulatum*. Diagram of portion of transverse section of body through esophageal region, showing an efferent nephridial duct (*nd*) opening into lumen of esophagus and another (*nd'*) leading to dorso-lateral surface of body. Reference letters as in Fig. 1.  $\times 50$ .

The nephridial system appears to be continuous throughout its whole length. From the larger canals originate both the ducts opening into the esophagus and those opening externally (Fig. 3). The excretory fluids may be discharged in either

direction, but probably pass mainly into the esophagus. Such a disposition of these waste products need not occasion any surprise when one considers how important a part the esophagus plays in respiration. I have often observed a species of the genus (*Tæniosoma delineatum*) with its mouth and esophagus widely dilated, while the rhythmic contractions of the body walls caused a comparatively large volume of water to be taken into the esophagus and then discharged through the mouth. In this manner the walls of the esophagus are constantly bathed with a regularly changing supply of water. Excretory products poured into the lumen of this portion of the alimentary canal would thus be quickly discharged from the body through the mouth. When, on the other hand, the esophagus is filled with food—a large annelid, for example—the pressure on the esophageal walls would very likely be sufficient to close up the nephridial ducts opening into this cavity, and in such a case the efferent ducts opening externally would be brought into service, and the excretory products be discharged through them.

The path from the nephridial canals to the esophageal lumen is much more direct than that through the thick muscular walls to the exterior of the body. Hence, with an abundant means of constantly flushing out the esophagus in the act of respiration, the animal economy is as well served by the discharge internally as by a direct flow to the exterior.

Only in such forms as have large mouths and use the esophagus as a respiratory organ would this be the case, however.

Although the two species mentioned are the only nemerteans in which this peculiar condition of the nephridial ducts is known to exist, yet in one other species of the same genus (*Tæniosoma indicum*) Punnett<sup>1</sup> has found fine cords of cells resembling delicate ducts, compressed so as to obscure the lumen, passing into the epithelium of the esophagus, although no actual openings were found. Neither did he find any ducts opening externally. And in some of the other species, belonging to different genera where careful study has as yet failed to recognize the efferent ducts, perhaps

<sup>1</sup> Punnett, R. C., "Fauna and Geography of the Maldives and Laccadive Archipelagoes," Vol. I, part I, p. 105, 1901.

a search for the esophageal nephridial ducts would meet with success.

Obviously the excretory apparatus of the nemerteans has undergone numerous and striking modifications from the primitive planarian type so well represented in the Bdellonemertea and in numerous species of each of the other orders.